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Editorial

Tectonics: Instrument for International Cooperation

The eesrch for waye in which to establish significant end mulually beneficial cooperation with similar scientific sociewas in other perts of the world hae bean a high priority of te AGU Committee on International Participation (CIP). The recent egreement with the European Geophyeical Sodely to copublish the new journal, Tectonics, is a solid schlevement resulting from thie affort.

Using e joint publication as an instrument of truly meaninful collaboration was conceived in preliminery discussons of the CIP with the president of EGS at the annuel meeting in Toronto, May 1980, end become e reality with the acceptance of e proposal from AGU by the EGS Coundial its meeting in Uppsala, Sweden, in August. Although there ere meny eubfields of geophysics in which a cooparefive publishing venture might heve been initiated, the decison of the AGU Council at the Baltimore meeting to create Tectonics presented a splandid opportunity. The creation of a new journal, a rere occurrence, offered just the chence we had envisioned in general larms in Toronto. The quantity and quelity of research in tectonics in Europe ere vary high, so the merit of this perticuler proposel from the European viewpoint seemed clear. We are vary gled that the EGS Council egreed.

The newly appointed editor-in-chief of Tectonics, John Dewey, is en ideal pereon around whom to build this novel effort in international cooperation. His parsonal beckground and his scientific work have given him e solid bese of knowledge, experience, end contacts on both sides of the Allentic. A North American and a European aditor will work

with Dewey to provide the leederehip of the new journel. The goel of the AGU in creeting Tectonics is to offer e high-quality, prestigious outlet for the beel papers in the subject. The full perticipation by EGS in the enterprise guaranteee that at least a fair share of excellent European pepers within the scopa of the journal will eppeer in it. This ehould make the publication especially attractive to polentiel subscribers.

The moet Importent functions of AGU are the encouragement end dissemination of good science through meetings end publications. It is eppropriate that these ectivities have e central piece in our programe of international perticipetion. The mechanisme for joint aponsorship of meetings, for

exempls, Chapmen confarences, heva long axislad, though parheps have been liftle used, in the international erana. This expertment in cooperation through a joint publication represente a new high in Irua coffaborellon of Iwo geophysical eocleties. The new journal will succeed or fell on the baels of its quelity end appeal to a substential number of raaders. The innovalive nature of its eponeorahip ehould

halp in the queet for excellence. The CIP hee eought weye to go bayond lokan axprassions of Irlandship and goodwill in guiding AGU policy as ragerde other national gaophysical sociatias. Genuina progress hae been mada, aspecielly in relatione with the Cenadian end Mexicen geophysicel unione, as well ae EGS. A joint publishing vanture la not necassarily a modet to be copied in future agreements, but it does show how imegination and a epiril of collagially on both eidas cen lead to a productive result when en opportunity presents itself. Our efforts to bridge internetional boundaries to the banafit of all gaoscientisis will continue.

Cari Klselingar Foreign Sacretery

News

Solar Mesosphere Explorer Launched

The Solar Masosphere Explorer (SME) epacecreft was launched into orbit from Vandenburg Air Forca Base on October 6, 1981, et 11:27 UT. The epececraft is in a naar-circular orbit at 540-km altitude and hes the proper inclination of 97.4° to eesure a 3 A.M.-3 P.M. sun-synchronous orbit. A orbit parameters eppear nominal

The SME spacecraft is deelgned to atudy the influence of changing eoler ultraviolet radiation on the density of ozone hithe earth's upper stratosphera and meeosphere. The satsiils carries five scientific instruments, three to measure the distribution of ozona; en ultraviolet spectrometer measuring the back-scettered radiation between 255 and 310 nn, so infrered rediometer measuring tharmel emission from ozone at 9.8 µm, and an infrerad spactrometer measuring the 1.27 µm airglow emission resulting from ozone photolyeis, in addition, the infrared radiometer measures the temperature of the atmosphera es a function of pressure end aithiude by measuring the thermal emission in two perions of the 15-mm CO2 band and the water vapor densiy by measuring the emission in the 8.3-µm band. A vielthe light spectrometer measures the density of nitrogen dioxide in the atmosphere by measuring the differential ab-

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Cover. Southsastem Saring Sea shelf, showing approximated locations of the Inner (~50 m depth), middle (~100 m), and shelf location and into distinct cosmoorants in the common shelf cosmoorants in the common shelf common shelf

Ceanographic domains, (See article p.730, The Oceanography

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lys Director Emeritus.

. Richman; Editor's Assistanti Sandra R. Marks; Eos Pro-

eorption of scattered sunlight at two wavelengths neer 443 nm. The four elmospheric instruments will view the earth's limb once every 12 s in the plane of the orbit es the spacecreft spins et a rele of 5 rpm.

Another epectrometer is designed to monitor the soler ultraviolel flux from 120 nm to 310 nm. The SME setellite will elso eludy the effect of cherged perticles entering the eerih's atmosphere es e resull of soler proton events to determine tha relationship between the megnitude of the

event end the observed decreese in ozone density. The establite is opereded from e control center at the Leborstory for Almospheric and Spece Physics (LASP), University of Coloredo, Boulder. The mission control center is etelled by undergreduate end greduate students from the University of Coloredo. The SME Investigator learn is composed of scientists from the Leboratory for Atmospheric and Space Physics and the Department of Astro-Geophysics at the University of Colorado, the National Canter for Atmospheric Research (NCAR), the National Oceanic end Atmospheric Administration Aeronomy Laboratory (NOAA), and the Jef Propuleion Laboratory (JPL). Teem members Include C. A. Berth (PI), G. J. Roltman, R. J. Thomes, G. H. Mount, G. M. Lawrence, G. E. Thomas, A. I. F. Stewart, C. W. Hord, and D. W. Rusch of LASP; J. London of Astro-Geophyeics: J. C. Gille, P. L. Belley, P. J. Crutzan, end R. E. Dickinson of NCAR, S. C. Lui and J. F. Noxon of NOAA; end C. B. Farmar of JPL.

The Solar Mesosphare Explorer mission is a project of the Neilonal Aeronaulics and Space Administration and is managed by the Jet Propulsion Laboratory. The Instruments were designed, fabricelad, and testad at LASP. The epacecrafi was designad end built by Bell Aerospeca Systems Division in Boulder.

This naws item was contributed by Devid W. Rusch, a research associate at the Laboratory for Almospharic and Space Physics, University of Colorado, Boulder. %

NRC Fayors Original Solar Mission

Following e raview of alternativae to the International Soler Polar Mission (ISPM), e National Research Council panel concluded that the original mission with Iwo space probee would provide nat banefile 'much graetar' Ihan any of the scalad-down options. Now slated for leunch no earlier Ihen 1986, ISPM was to be tha first exptoration fer out of the ecliptic plane in which the planets orbif the sun.

The original ISPM plens called for the European Spaco Agency (ESA) to build one space probe end for the Nalional Aeronautics and Spaca Administration (NASA) to build the other proba, which would include X ray, extrame ultraviolat, end visible fight instrumente to take images of the sun. Both probes were to be leunched by NASA. Budget cuts earlier thia year (Eos, Merch 24, 1981, p. 123) helted the development of a U.S. spacacreft for ISPM. In June, following protasts from ESA end others, Congress partially restored ISPM funding and requested a review of allerna-

Five versions of the soler mission were reviewed by the NRC panel: the original two-proba ISPM plan, with an estimated cost to the U.S. of \$410 to \$416 million; an ESA probe and a modified NASA spacecraft carrying only a singla imaging inatrument (estimeted U.S. cost: \$380-5430 million); ona ESA and one NASA spacacraft, both without maging (astimated U.S. cost: \$310-\$330 million); two ESA spacecreft, both without imaging (astimated U.S. cost: \$235-\$250 million); and a aingla ESA spacacraft (astimated U.S. cost: \$110-\$130 million).

Copias of the panel's report, 'The International Solar Poler Mission, A Review and Assassmant of Options, may be obtained from the Committee on NASA Scientific end Technotogicel Program Changaa, Netional Rasaerch Council. 2101 Constitution Avanua, N.W., Washington, D.C. 20418. Allan E. Puckati, at the Hughes Aircraft Co, to Culver City. Calif., chaired the NRC raview panel. 5.

An Invitation to Contribute Papers of Interest to

tectonics John F. Dewey, editor-in-chief

Paul Tapponnier, europeen editor B. Clark Burchfiel, north emerican editor A new international journal Copublished by the European Geophysical Society and the American Geophysical Union

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Papers are to be complets works; short notes and progress reports are inappropriate to the focus of the journal. Original research papers ara sought.

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A Synopsis of PROBES

J. J. Goering and C. P. McRay

Introduction

The Processes and Resources of the Bering Sea Shelf (PROBES) project is a 6-year multi-institutional (University ol Atasko, Floride State University, University of Washing-Ion, Brookhovon National Laboratory, Southwest Fisheries Center, Bigelow Leboratory for Ocean Sciences) inlerdisciplinary study dosigned to understand the processes thet contribute to the production of enermous numbers of antmais (including crabs, lish, birds, manimals) in secondary and higher trophic levels in the vast Boring Sea continental shelf. The research pten is based on the hypothesis that the broad shallow shell leads to an oceanographic struclure of e semi-parmanent front-interfront system in which phytoplankton primary production is coupled to e pelegic lood web over the outer shell and to a benthic tood web in the middle sheft (see covor, this Issue). The project has concentrated on the processes that control the survival of the aarly life history steges of the Alaska pollock (Tharagra chelcogramma Pallss) as an example of mess and energy transfer in the pelegic system. PROBES began in 1976 end is sponsored by the Division of Polar Programs, National Science Foundation

PROBES is organized into five major components of reseerch: (1) weler circulation and mixing, (2) nutrient dynemics, (3) primary productivity and phytoplankton ecology, (4) upper trophic-level ecology, and (5) ecosystem anst-

ysis and synthesis. The justification and need for PROBES is derived from national and internellonal interests in science end aconomics. The Bening Sea is the third largest sea in the world, exceeded only by the Medilerranaan and South China seas. About 45% of its area is continent of shelt constituting the lergest American coastal sea and containing Immense quantities of renewable end nonrenewable resources. The yeerly economic value of its tishery resources (~5% of tha lotel annuel world catch) is several hundred million doltars.

Nominations are invited for

The award will be presented at a banquet at that time.

wood, Kennath Emery, and John Sciater.

nized impact on our understanding of the marine environment.

1982 Rosenstiel Award

This award, which is administered on behalf of the Rosenstiel School of Marine and Almospheric

Science (RSMAS), University of Miami, recognizes outstanding contributions to marine science, in-

cluding oceanographically relevant aspects of atmospheric science, and fundamental developments

in ocean engineering. The award consists of a cash prize, currently \$5,000, and a medal. The recipi-

ent of the award will be invited to spend a week at RSMAS for discussions with faculty and students.

rotating basis, echlevements in four broad disciplinary areas. In 1982 the omphesized discipline will

be marine geology and geophysics. The achievements recognized may consist of contributions to

wards the development of ocean science in general, or of more focused individual research or recog-

Nominations for the 1982 award for outstanding echievement in marine geology and geophysics

should be directed to the Interim Dean, Warren J. Wisby, Rosenetiei School of Marine end

Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Flori-

da 33149, before March 15, 1982. Nominetions should include a brief justification together with

relevant references, and a c.v. if possible. The selection panel would especially welcome nomins-

tions of outstanding youngar scientists whose early contributions suggest a continued role of leader-

Previous recipients of the award in Marine Geology and Geophysics have been Edward Ring-

To accommodate the multidisciplinary value of oceanographic science, the award recognizes, on e

The U.S. fishing ectivities have been contined largely to king end lenner crebs end ssimon, while for many years the loreign fishing fissle of Jepsn, Kores, end the Soviet Union have extensively exploited stocks of verious lin-tishss (e.g., Alsska polisck, yellow-lin sole). This see pleys e major role in supplying merine protein to many nations and siso hee many basins with excallent petroleum potential, and extensive patroisum exploration is in the planning procese. The results of PROBES will be velueble in providing an ecological basts for managment aspects of the resources of this and other high letitude continental shelves. The growing ewsrenses of the importance of oceenic fronts in regulating oceanic productivity and chemistry, and in concentreling tood end enimele at all trophic levals in food webs, is edditional justilication for sludies such as PROBES.

We ettribute the success of PROBES es e multi-discipilnery team sludy to the strong cantral hypothesis that was formulated end revised with intermetion made evetleble from the collective efforts of ell PROBES investigatore. The present hypothesis is substentially different from our initial understanding of how this shetf scosystem functions. The results of early PROBES end the Bureau of Land Menagamant/National Oceanic and Almospheric Administration sponsored Alasks Outer Continental Shelf Environment Assessment Progrem field work revesled e very different pettern of ecosystem afructure and function from that initially hypothesized. In the following sections we summerize PROBES resulte thei support the general hypothesis that melor pelogic and banthic food wabs leeding to lerge stocks of animets are separated in space end ere orgenized in roletion to the three oceanic fronts that axist in the southeestern Bartng See.

Water Circulation and Mixing in the Southeastern Bering Sea

Three Ironts separele the wetere overlying the southeestom Bering See shelf into three distinct hydrographic domains (sea cover, this issue). Esch dometn has distinct tempereture, salinlly, and strellficetion properties, end eech has different dirculation feetures [Coechman et al., 1980]. The shelf break front to within ±50 km of the shall break (--170 m isobsfh), about 500 km from shore; the middle front lies over the 80 to 100-m isobsths, 350-400 km from shore; and the Inner front is centered over the 50-m fsobeth, 80-150 km from shore. Proceeding landward from the shelf break front the hydrogrephic domeins are called outer, middle, end coestal.

Fronts are regions of convergence in the horizontal transport (flux) of water properties in the direction normal to the Iront, over the weter column depth encompassed by the front. On the shell of the Bering See, selt is essentially conserved in both time and space, and sellnlty cen be used to describe the fronts. Other properties such as temperature, nutriente, and biological meterials (e.g., chlorophyll) frequently depict the Ironis. The fronts siso border changes in verticel water column structure.

The broad shelf breek Iront (~50 km wide) extende along the shell edge from Unimek Island to Cepe Navarin. It designetes the outer boundary of a less sating shall water converging with oceanic water. An enhanced meen selinity gradient of $((\Delta S/\Delta X) \sim 10 \times 10^{-3} \text{ g kg}^{-1} \text{ km}^{-1})$ increasing seawerd end extending down from the surface over tha upper two-fhirds of the weter column datinee this iront. The ectual orientetion of the convargence zone is not verticel but slopes from the euriece landwerd et ~1.5 to 2 m/km. A eimilar enhanced horizontst gredlent of mean sellnity and lamperelure in the bottom one third to one hell of the weter column describes the middle tront end elso merks a transi-

in Oceanographic Science

PROPERTY SEWEETHE ⇒ / salt

Fig. 1. A schematic disgrem of the mixing energy balance in the different domains and associated water column structures. Note the correlation of the fronts with regions of greater bottom elope. Also indicated are generalized isopisth distributions and set and treshwater fluxes [from Coachman et al., 1980].

tion in verticel weter column structure (Figure 1). Landward of this front the middle domein le two-teyered, while sasward the upper end lower reletively mixed tayars are separated by e third leyer replete with tins structurs. The 15 to 20-km wide inner front is also a region of change in water column structure, from two layers in the middle domain to verticelly well mixed in the coestel domein. The inner iron has meen horizontal aslinity gradients of ~2 × 10⁻³ g kg⁻¹ km⁻¹ end is elso leyered, the gredients being more strongly developed in the lower half of the water column. Horizonlel selinity gredients are low (~1 > 10⁻³ g kg⁻¹ km⁻¹) ecross the middle domain, while in the coestel domain gradients ere en order larger (~10 × 10⁻³ g kg⁻¹ km⁻¹).

The Bering Saa ehelf breek front is anelogous with other extensively etudied mid-letitude ehelf edge fronts such as those of the mid-Atlentic Bright and Nove Scolie. The Inner front eppeare cherecteristic of the shelf fronts described eround the British leles, while the middle front may have counterperts in other very broad mid-latitude ssas (e.g., North See, Eest Chine Sea).

The circulation on the southeastern Bering See shall is tidelly domineted. Extensive moored current meter and setellite drifter observations indicate sceler meen tidal speeds of ~20 to 25 cm/s, increesing shoreward, and most of the horizontel kinetic energy is at tidel irequencies, varying from 60% over the outer shelf to >90% in the cossial domain. Subfidel flow le wesk (1-5 cm/s) and parallel to the fronts in the vicinity of the shell break end inner fronts, while flow in the middle domain is insignificant. No evidence exists for mass or momentum exchange between this shelf and adjacent oceanic wetere by eddles or current rings. Because some Ireshwater le continuelly edded by lend runoff while the long-term eatinity field is essentisly conelent, on-off shelf fluxes of freehweter and salt are conthuous end primerly tidelly driven. A hypothesis explaining the Baring See shelf fronts based on the conservetion of salt is discussed by Coachman et al. [1980].

Coachman et al. [1980] have described the mixing energy belence end the associated weter column structure on the southeasiam Bering Sea shelf. The Inner end middle fronts ere tormed where vertical fluxes of water proparties are anhenced by physical conditions concomitant with s besic change in water column etructure. Structuref change a trom one to two leyere at the Inner front and from two to three et the middle front. The changes occur where the boltom depth exceeds the depths of belence between Ildal mixing energies from the bottom up against buoyency and wind stirring downward from above. As these energies are approximetely constant over the shell the thickness of the layere containing lidet end wind mixing energias is siso ebout constent, thus where depth changes the structural layaring of the water column also changes. These conditions, togather with generalized vertical property distributions end fluxes on the eoutheastern Baring Ses shall, see summerized echematically in Figure 1.

Upwsiting in the middle end inner fronte is a consequence of flow convergence, to the middle front, convergence la primerlly due to a landwerd aubildal llow baneath 30 m ol ~2-3 cm/e across the outer domain. The onshore offshore aubtidel flow ta veriable over 1-5 dey periods, and hence the intensity of convergence eppaers to be directly correleted to etmospheric evanta. This convergence results In everege upwelling of ~10-3 cm/a. Continuity is praserved by dispersion in the surface layer. The inner front conditione appear to be similar to those of the middle front There is elso upwelling at this front, and mass redistribution drives e small berodinic current to the north perellel to the tront which assists in maintaining continuity.

Role of Fronts in Southeastern Bering Sea Food Webs

Information relative to the effects of frontal zones on phyloplenkion and zooplankton production, species composition, end community etructure of high letitude shelves is aparae, but it is oleer that frontal zones are often regions where biological productivity is much greater then that of the water mass on either side of the front. PROBES Is atudying the processes that maintein high primary productivity in the processes and the processes are processed in the processes and the processes and the processes are processed in the processes and the processes are processed in the processes tivity in shalf frontal zones as well as the mechanisms that lead to the transfer of mass and energy from primary producere to and between consumers.

In the shelf domaine of the couthecetern Bering See the patterns of phytoplankton end zooplankton growth, blomass, and species composition are organized in relation to COPEPOD DRY WEIGHT

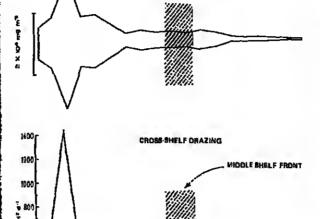


Fig. 2. Southeestern Bering See cross-shelf measured copepod grazing, dry weight, and species distributions (May 1979). Note position of middle front (modified from Cooney and Coyle

the three fronts. Enhanced biological ectivity takes piece preferentially within the surface tayer near irontel zones; enhancement is particularly evident in the middle front where convergence of oceanic-derived materials and nutrients in lower layers leads to property upwelling. The middle front also acts as a substantial barrier, merkedly reducing the landward cross-shelf transport of plenkion and other particulate and dissofved materials. The tocusing of materials along this front undoubtedly accounts for the notable enrichment of biological ectivity observed at this tront [/ver-

The sequence of spring phytoplankton events end spedes succession differe in the middle and outer shell domains which ere separated by the middle front. Light, nutri-mis, grazing, and vertical turbufence all influence the growth end structure of phytoplankton communities. Turbulence, in particular, assumes an importent role in controlling initiation of the epring bloom. The bloom commences first in the middle end coestal domeine; these ere also areas of

gest blcom davelopment. The time course of spring phyloplenkion blooms in the nodis domain has been observed for savaral years. in-Geases in vertically integrated chlorophyll concentration ocour siter breaks in the normal pattern of etorm movement (Several per week) through the southeastern Bering See. During the past 3 years, favorable periods of water column stabilization for bloom initietion have appeared in eerly May. The tals of the seesonal production cycle siter bloom niliation is elso largely detarmined by the vagariee of slorm Wenis and their effacts on the wind mixed layer. Meteorowicat events thus play an importent role in regulating the mary production cycle on the southeastern Bering Sea shelf, as well as influence the Intensity of convergence at the middle front and raeupply of nutriente to the poet bloom

The typical cold, northern high latitude assesonal phytoplankton successional aequance davalops in the Bering Sea middle domain but not in the outer domain. In the outof domain much of the esseonal productivity (~200 g C 17") is associated with Phaeocystis pouchetil, a nonsificacus haplophyte, whereae in the middle domain sucpassional elages of diatoms are responsible for most of the Moductivity (~400 g C m⁻² yr⁻¹). The smell sized dialoms of the genera Thelassosira and Chaatoceros dominate lage I; medium sized dietoma of the ganara Chaetocaros. Cotelhron, Phizosolenia, and Nitzschia dominste stage it; and large long chained Rhizogolenia alata, which can grow under low nutrient conditions dominate stage III middle domen phytoplankton numbers. Eyidance from grazing exments suggeste that most of the outer shelf dietom production is grazed by large North Pacific Interzonal epecies of calahold copepods and euphausilde (a.g., Calanue crisilus, C. plumchrue, Eucalanus bungil, Eucalanus Inarmis, and Thysanossa reschil), which do not graze Phaeocysils Cooney and Coyle, 1981]. The outer shall domein phyto-Plankton community le held successionally alatic during spling by heavy grazing, which produces the observed low and diversity and high dominance of Phaeocystis. The large herbivorous copapode and auphauelids of the outer shell grazing community are restricted to the outer shelf do hen by the physical constraints imposed by the middle lont Although small copepods (e.g., Pseudocalanus spp.

Olthone similis, Acartle longiremis) are distributed ecross the whole shelf, the greating stress on dietoms is tower in

the middle domein than in the outer shelt domain. The large ouler shell copspods have monocyclic lite cyclss with ontogsnetic vertical migretions, in which growth and development of the copepodid steges take plecs in surface wetsr, but reproduction occurs during winler in dssp water off the shell in the absence of food. Juvenile sleges migrete to the surface before spring bloom initiation and bagin grezing as the bloom develops. The smaller numerically dominant species of the middle shelf produce severel broods per year only eller icod (phytoplankton) becomss ebundant. Thus Intense spring blooms of phytoplankion develop in the middle domain belore extensive grezing begins, and grezing by these smell species never harvasis e lerge amount of the phytoplankion production. Thus underuse of phytoplenkton results in significant transport of phytopiankton datritus to the seabad in the middle

The differential grezing etress imposed by the physical condillons that prevell on the southeastern Bering Saa shalt reguletss the patterns of phylopienkton productivity and signding crop as well as pertitions the shell into two reglons, one domineted by e psiegic food web (outer domsin) and the other by e benihic food web (middle domsin). The outer shelt domain is charecterized by lower standing stocks of phytoptankton and by absence of e wall-dalined spring bloom. The large harbivorous grazers conlinually harvast a major portion of the primery production in the outar shelf domein, and this teads to e predominantly petagic food web in this region of the shall. However, in the middle shell, eubeteniisi smounts oi primary production are unharvasted by the smeller copapoda, end much of it is available lo banthic-type food webs. The differences between domeins in the levels of primery productivity end grazing result in over 3 times more phytoplenkton remeining ungrezsd in the middle domein then in the outer. The consequences of this cross-ehell pettern of productivity end grazing are also avident in upper trophic levels. The extensive pelegic lisheries of the Bering Ses are concentrated in the shelf break Iront and outer domein while the benthic related species (such as king crab end yettowtin sole) predominate in the middle shell,

Summary

PROBES is e multi-institutionel, interdisciplinary study of the merine ecosystem of the eoutheestern Bering Sea. The major alfort of the progrem is to understand the processes thet contribute to the large production of enimels in various trophic levels. The waters over this shell are highly structured end consist of discrete domains divided by three distinct oceanic Ironis. PROBES is examining the importance ol these fronts in regulating production of plants and animals and has discovered that these ironis are zones of enhanced biological ectivity and thei the patierns of phytoplankton and zooplenkton growth, blomass, and species composition are organized in relation to the Ironis. The middle tront, in particular, is a zone of enhanced biological ectivity, and it seperates the middle shall benihic dominaled food web region from the outer shell pelagic lood web dominated region.

J. J. Goaring end C. P. McRoy ere with the institute of Merine Science, Univarsity of Aleske, Feirbenks.

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Information Report

IUCRM Symposiu

The 8th Inter-Union Commission on Redio Meleorology (IUCRM) symposium was held on May 13-20, 1981, in Miamf Beach, Florida. The topic of the symposium was 'Weve Dynamics and Redio Probing of the Ocean Surlaca. Tha eymposium was also eponsored by the Netional Aeronauitcs and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Nsvy through the Office of Neval Research (ONR). The American Meteorological Society (AMS) participated in the

The purpose of the symposium was to review in dapth the theoretical, experimental, and observational developments of the past few years and the presentation of new research results in basic weve dynamics, oi wind-wave spectra, and interactions with oceanic etructures, meeeurements, end analysis techniques including microwaves, HF techniques, and claseical methods, 'Invarse' modeling, wave prediction, and related topics such as oceanic turbulence and upper ocean fayer dynemics.

The program/organizing committee coneisted of Sir George Deacon, Instituta of Oceanogrephic Sciences, Wormley, Godalming, Surrey, U.K., honorary chairman; Owen M. Phillips, Department of Earth and Planetery Sciances, The Johns Hopkins University, Baltimore, Md., chsirman; Kieue Hasselmsnn, Max-Planck-Institute for Mateorology, Hemburg, Fsd. Rsp. of Germany, co-cheirman; Donstd E. Berrick, NOAA Environmentat Research Leboratory, Boulder, Colo.; Acad. L. M. Brekhovekikh, Institute oi Oceanology, Moscow, USSR; Fred W. Dobson, Bedford Institute of Oceanography, Dartmouth, Canada; Norden E. Husng, NASA Wellops Flight Center, Wallops Islend, Ve.; Robert B. Long, NOAA Atlantic Oceanographic & Meleorological Laboretories, Miami, Fle., Cochairmen of locel arrengsments; M. S. Longuet-Higgens, University of Cambridge, Cembridge, U.K.; Weller H. Munk, Scripps Instillution of Ocasnography, La Jolie, Cettf.; Duncan B. Ross, NOAA/AOML, Miemi, Fla., chairman of local arrangements; Y. Toba, Geophysical Inetituta, Tohoku University, Sendet, Japan; G. R. Velenzuela, Naval Research Laboretory, Weshington, D.C., secretery; Sture Wickerts, Nellonel Defense Research Institute, Stockholm, Sweden, cheirmen ol

This IUCRM symposium, in contrest to previous ones (excspl for the one in Venice, Italy (sst yeer), was 'open' end ettended by 181 (the estimated count was closer to 200) regletered scientists end other observers; two thirds were from the United States. The eltendence included ocesnographers, meteorologists, geophysicists, end about one-lhird redio scientiels from 15 countries (i.e., Austrelia, Censda, Peoples Rsp. of China, Denmerk, Frence, Fed. Rep. of Germany, Ireland, Itoly, Jepan, Mexico, The Nethsrtends, Norway, United Kingdom, United States, end

The opening caremonies of May 13 included introductory remerks by Sir George Deacon and key nota oddreeses by Herbart Rabin (Deputy Assistant Secretary of the U.S. Navy), Williem Reney (Deputy Administrator for Science and Applications of NASA), and Ferris Webster (Assistant Administrator for Research end Dovelopment of NOAA).

The technical program included 6 review papers, 61 research contributions, one open workshop, end 30 postor papers. The proceedings of the symposium including coin ments end discussions during the presentations witl be published by Plenum Press in book form with K. Hassetmann and O. M. Phillips serving as editors.

Overall, this IUCRM Symposium was a graat success, helping to bring together once more ocoanographors and redlo scientists on the one hand and theoreticians and exportmentalists on the other. One of the main autputs of this meeting was the acknowledgment that microwave remote sonsing techniques from satellite, aircraft, towors, coastal plars, and in the laboratory offer a new dimension to nieasurements of the air-soa/water interface. In net result. these tachniques are becoming widely accepted by oceanographers and geophysicists, and a number of them are planning to use these instruments in the near luture. We should thank our lormer colleague, the late John W Wright from the Naval Research Laboratory, for this state of allairs, since he was one of the pioneers in radio-oceanography and made Important contributions to remote sensing end ocaanography. As a maller of fact, his name was often quoted throughout the meeting.

The main interests in the listd now are in the nonlinear

processes of the surface wave field, the directional spectrum of ocaen waves, and in the validation improvement of wave prediction models. Some spectic htghlights of the symposium era given below. Theoretical and experimental evidence (weve tanks) was given of strong nonlinear interections of water waves that tead to subharmonic instability. wave breaking, group splitting, crest pairing, etc. For ocean waves, the experimental evidence continues to support the concept of waakly interacting free weves with a unique dispersion relation, end nonlinear effects amount to no more than ebout 10%. The directional spectrum of ocean waves may be obteined from aircraft with singla- and dual-trequency short-pulsed microwave radars and with groundbased HF systems. The microwave ellimeter from aircraft and satellite is abla to profile ocean waves with high precislon, but nonlinearilles of waves can introduce a bias in the meen ocean level as large ee 80 cm. The SEASAT SAR yields the wevelength of oceen waves within 12 ± 7% end wave direction within 12°-15°. Longuet-Higgins presented a real breakthrough in anelytical modeling of the 'overturning' fluld in plunging, breeking waves. Breaking waves contribute en unusuelly large amount of backscatler lo microwave remole sansors. Coherent microwave radars may be the Idael instrument for Investigating the elusive process of wave breaking. HF lechniques are capable of determining e number of parametere of dekameter ocean waves, tncluding near suriece oceen currents. Theoreticel and experimental trivestigetions were presented on the generation waves the coupling of short waves with long grevity waves, and on the weve-induced flow in the air. The statistics of zero crossinga end other paremeters of wind waves were invastigeted in a wave tank, and they were in qualitative egreement with Longual-Higgina' earlier predictions. NOAA's Coastet Wave Program was reviewed, together with remote eeneing experiments such as ARSLOE. future experiment to delinable the processes that leed to surface expressions of bathymetry in the weve field and reder Imagee is being organized (SEBEX). Mesoscale lurbulence processee were discussed in regard to wind measuremente from rader backscatter. The eymposium closed with an open workshop on Wava-Model Intercomperison, organized by K. Hasselmenn. The objective was to test the numerics end physics of a number of wave prediction modele fhet use discrete epectral, parametric, and parametric. hybrid techniquas. These wave prediction models were applied to six prediction teets: limited fetch and duration, signting faich, windy half-plane, diagonal front, and atationary and moving hurricanea. For single prediction situations, all wave modale baheved in similer fashion, after the numarks had been corrected, and the quality of the prediction depends mostly on the eccuracy of the wind field used. However, for extreme situations such as hurricans conditions, a wide epread of enswers resulted. For stationery hurricanes, the significant wave hetght varied from 10 to: 25 m and for moving hurricenes the apreed was 10 to

20 m. Presently, II is not possible to aggess which of these predictions is correct aince there is no complete deta set on extrema conditiona. The result is that further tests are warrented with these models, and additioned dete on hurricene conditions are urgenily needed.

The Progrem/Organizing Committee is most grateful for the generous financial support of NASA, NOAA, end ONR end would like to commend the efforts of the Local Arrangements Committee composed of Duncen Ross, Bob Long, their wives and the American Meteorological Society.

G. R. Velenzuele is with the Environmental Sciences Division, Navai Research Leboratory, Washington, D.C.

News and Announcements

JGR on the South Atlantic Bight

A apecial issue of the Journal of Geophysical Research will be devoted to scientific results from studies of physical processes in the southeest U.S. confinental shelf and adjaceni Guil Stream waters. Individuale who have worked in this area, especially in regard to Gulf Streem meanders and ehingles, interection with shell water, topographic influencea, wind influences, and shelf droutetion, are encouraged to eubmit menuscripts for this lesue.

To aid in planning this leave, please inform Thomas N. Lee, School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miomi, Fiorida 33149 (telephone: 305-350-7491) of the tentalive title of your menuscripi and authore by December 1, 1981. Manuscripis ahould be submitted in quadruplicate before April 1. 1982, Io A. D. Kirwan, Jr., Editor, JGR, Department of Morine Science, University of South Florida, 140 Saventh Avenue South, St. Pelersburg, Florida 33701. Stendard JGR review procedures will be followed.

Adopted: A Practical Salinity Scale

The Unesco/ICES/SCOR/IAPSO Joint Panel on Oceanographic Tables and Standards has recommended the edoption of a Practical Salinity Scele, 1978, and e corresponding new international Equotion of State of Seewater, 1980. A full account of the research leading to their recommendation ta available in the series Unesco Technical Papers in Merine Science.

The parent organizations have accepted the panel's recommendetions and heve sel January 1, 1962, as the dele when the new procedures, formulae, and lebies should replece those now in use.

So ler as users are concerned, little is needed except the use of the new international Oceanographic Tables or equations: These, logether with an explenatory introduclion, will be made avellable by the Unesco Division of Marine Sciences as soon as possible.

Att oceenographers are urged to use the new tebles or equations for work reported on and efter January 1, 1982. They should note in particular that the use of the new international Equation of State of Seawater, 1980, requires that use of salinity values determined on the Practical Salinity Scala, 1978. To avoid confusion, authors and editors are particularly requeated to ensure that during the period of change, published values are accompenied by an indication as to which lables or equations have been used in their determination.

Oceanography Luncheon

A reminder: There is a limited number of tickete for the Oceanogrephy Section Luncheon, scheduled for December 9, during the AGU Fall Meeting in San Francisco. Be sure to purchase your ticket early to ensure attendance. The luncheon speaker, Farris Webater, will talk on the 'Research Oullcok Irom NOAA.

U.S.-Soviet Teem Explores Polynye

Salellite pictures in 1973 of the frozen Weddelf Sea near Antarclica revealed an unfrozen 'lake' surrounded by ice. In aubsequent wintere, the curiously unfrozen patch appeared, disappeared, reappeared, grew to neerly 300,000 km², and drilled westward before venlshing. The source and the eflects of this unfrozen leke on its aurroundings mey remain a mystery for not much longer: A joint American-Soviet teem recently began a 2-month, on-site investigation of the an for unifozen water surrounded by

Two explanations for the polynya's existence predominete. One is that a strong wind blows ice away before a significant amount can accumulate, according to Arnold L Gordon, Eos essociata editor and professor ol geological scioncas al lhe Lamont-Dotterty Geologicei Observatory. He is coordinating the expedition with the Arcilic and Antarctic Research Instituta in Leningred. 'The other is that for some reason, enhanced convection is going on in this region. Basicelly, we think thet the polynya is caused by upwelling of ocean heet rather than ice being removed by high winds.'

Tha surface waters aurrounding Anlarclice normally ere irozen or almost so, Gordon explained, bul at 200 m below the surface, the water's temperature is about 2°C. Warm water riaes to mix with colder surface water, but such convection isn't strong enough to melt the Antarctic ice.' Such

le the puzzle of the polynya.

More than being e quirk in the ice, the polynya may aflect world climate and the distribution of nutrients in Antaiclica's watere. Because of the heat lost through the polynye, there is a major cooling of the abyssal ocean going on, which is importent from a climetic point of view, Gordon sald. Much of the waters below 1,000 m in the world's

oceans ere derived from the Anterctic.' In addition, the polynya may eleo affect organisms in the food chsin, such as the tiny, ahrimplike krill that are found in abundance in the Anterolic waters.

Satellites have not yet reveeled a polynya this auatral winter, but a slight decrease in ice concentration has been Inferred from satellits observetions near 66° South, 5° East. Scientists are hoping that this westening of the ice cover will develop into a polynya. 'If nons does appasr this austrai winter, we will study snylronmental conditions within ths ice peck. Such a study has never been done before near the period of maximum extent,' Gordon seid. For exempls, the American-Soviet research team will attudy the thickness of the enow cover end the structure of the ics in an attempt to determine how the ocean is giving up heat to the atmosphere. The chemistry and biology of the prospective polynye end the surrounding erea also will be atudied.

Of the expedition's 28 scientiats aboard the 137-M Soviet icsbreaker Mikhell Somov, 13 ere from the Sovist Union. The American team includes nine Columbia University scientials and four others from Orsgon State University and the U.S. Army Cold Regione Research and Engineering Laboratory in Hanover, N.H.

OTA: Shore Up Federal Ocean Programs

Although the lederel ccean effort conaista of about 90 programs, et a cost of \$2.52 billion in liacal 1980, there is no comprehensive plan or coordination for the development ol new technologies to advence the programs, according to a report by an Office of Technology Asaesement (OTA) panel. Federally supported technologies include ships, eatelfilea for oceanogrephy research, buoya, aubmeralblee. and independent instrument ayetems. To shore up the devalopment of ocean technology, Congressional initiatives may be necessary, concludes the Tschnology and Oceanography Assessment Advisory Panel.

There is no consistency, the panel charged, among agencies in their plana for future program or capital expendiluree. Furiharmors, some egencies plan for possible luture technology needs, while others do not plan for new expendilures until new items become vitel. And, some program plans include eubstantiel contingencies and related activities, while othera do not.

The 90 federal ocean programs are conducted primarily by eight agencies: the U.S. Coast Guard of the Department of Transportation, the Department of the Interior, the Environmental Protection Agency, the National Aeronautica and Space Administration, the National Oceanic and Atmospheric Administration, the National Science Foundation, and the U.S. Nevy in the Department of Defense. Three of these egencies—the U.S. Coaat Guard, NOAA, and the

U.S. Navy-accounted lor 80% of FY 1980 expenditures. To rectify the probleme, Congress could establish a centrei office to support luture oceen technology development, according to the panel report. Specific technology devalopment needs not being met by established offices also could be evaluated by Congress. Finally, Congress could establish an interagency ocean sngineering atratagy group to coordinate reaearch.

In ita report, 'Technology and Oceanography: An Assessment of Federal Technologiee for Oceanography Research end Monitoring, the panel identified issues in four main areas concerning federal activities: ocean technology development, oceanic data systems, ahips, and aateliite ocean-

Key to the Issua of ocean technology development la whether a larger and more centrelized ocean engineering effort within one or more federal agencies would significant ly improve the luture development of oceen technology. Proposels for a centralized organization have long been opposed. Many researchere worry that one centrel agency would not give individual programs the attention they deserve and would not allow the flexibility that programe require for budgeting, engineering priorities, or for the support ot smaller programs. OTA recognizes the drawbacks of a centretized organization: 'There is no way to centralize technology development adequately, statee the report aummery, 'to meet the individual needs of every program and agency. Direct communications between the programs needing technology and the developers of technology is most importent . . . and of utmost concern le assuring the availability of highly qualified pereonnel in each department or agency for critical progrem ageessment and for locusing on promising directions in technology development.

Can the growing need to handle and dietribute increasingly large volumes of oceanic dets to a veriety of users be met effectively within exiating agencies? 'Federal programa have not given adequate ettention to the handling end disiribution of oceanographic data, the panel maintains. Two steps need to be taken so that oceanic data will serve the growing user needs. First, OTA recommende, assign agency or program responsibility for comprehensive managemant geared to user needs. Then, choose a federal, regional, or private dale management eyatem end update it with modern lechnology. 'Congreas could initiate the firet slep by requiring that deta management for ell end-uaere

be included in plane end budgete for major new programs. OTA warned that the capabilities of the federal oceanographic fleet will continue to degrade without new funde or more efficient arrangements that will reduce costs. To aealst coordination among agenciee, Congresa could estabish end fund an interagency ehip planning council. Such e council could heve the authority to specify management and planning in an effort to reduce costs,

'Salellite remote sansing could become the lastast growing segment of oceanography if certain agency plane are followed, OTA sleted; they evaluated whether the benefits of this costly technology warrant the costs. Satellile technologies could aid in the rouling of ships, search and rescue operetions, end gether immense amounts of dets in a fraction of the time required by other methode. However, The extent to which setallites themselves will add naw knowledge end thue justify very large costs is difficult to avaluate until more experience la obtained, OTA claimed

The panel report was prepered at the request of the Senate Committee on Commerca, Science, end Transportation D. James Baksr, Jr., of the University of Washington, chaired the review penel.-BTR

Meetings

Call for Papers

The 45th Annual Meeting of the American Sociaty of Ling. nology and Oceanography will be held June 14-17, 1982. et North Carolina State University, Raleigh, N.C. At the Releigh maeting, two special sympoela are being organizad: 'South Atlantic Bight Proceases,' chaired by David W. Menzel and Thomae B. Curtin; end 'Biological Effects of inorganic Turbidity in Lekes,' chaired by Samuel Moziev and John M. Miller. Deniel Karnykoweki, Department of Marine Science and Engineering, is chairman of the local com-

ASLO meetings are arranged into no more than four concurrent seesions of contributed papera during the 4-day period. Additional papers are presented as part of dally posier

The call for papere for the Raieigh meeting hes bean is eued with deadline for receipt of abstrects being January 15, 1982. Because of the large number of abstracts that are aubmitted, it is the eoclety policy only to accept abstracts from ASLO membere.

ASLO currently has nearly 4,000 members. The officers are Richard Eppley, Scripps Inetitution of Oceanography, president; David Schindler, Freehwater Institute, vice presi dent; Claire Schelske, University of Michigan, secretary; and Sumner Richman, Lawrance College, treasurer, information about memberehip and memberehip application forms can be obtained from Mre. Winifred Baumaister, Business Manager, ASLO, 1530 12th Avenue, Gralton, Wi

The eoclety publishes one journal, Limnology and Oceanography. The journal editor le Yvette Edmondson, University of Washington.

New Publications

Remote Sensing of Atmospheres and Oceans A. Deepak (Ed.), Academic, New York, xiv + 841 pp.,

Reviewed by Conwey B. Leovy

the book la anhanced by inclueion of the discussion accom-

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arrying sech presentation that servas the dual purpose of alerling the reeder to underlying ereas of concern in the reserch area and, in some casea, of clarifying just those whis that will be obscure to many readers.

Some 25 papere are included under the broad headings

d'Recent Advances in Inversion Methoda, 'Remote sounding of Atmospheric Paremeters' (with subhaudings of Jempersture, 'Aerosols,' 'Gaseous Conatituents,' end 'Minoweves"), 'Remote Sounding of Winds,' 'Remote Soundin of Ocean Parametera, end 'Interpretation of Recent Results From Space' (thia last being something of a catcha including resulte from new earth-viswing instruments as wall as from other pleneta). It is imposable here to detail all difie papere, but parhepa a lew highlighta will indicate the Many. Under the first heading, P. M. Toldalegi shows how the Kalman filter technique cen be combined with the outnut of a general circulation model to provide a highly adapwe solution to the problem of assimilating a global set of remaile sansing deta. J. Susskind and A. Roaanberg and E.W. Koanig than preaent two interesting papers on the (1979) stete of the art Tiros-N eystem, Susakind and Rosenberg on retrievals of a large number of soundings in the presence of variable cloud cover, and Koenig on the Tiros N HIRS/2 Instrument and its performance in orbit. Three papers discuss the Interpretation of optical measurements infarms of aarosol aize distributions (A. Deapak, M. A. Box, and G. P. Box), volatility (P. Hamili, T. J. Swiasier, M. Ostoms, and M. P. McCormick), and detailed vertical atructure (T. J. Pepin). A paper by S. L. Taylor, P. U. Bhartia. U.G. Kaveashaver, K. F. Klenk, A. J. Flefg, and C. L. Maleer on ozona retrieval uaing backecattered ultraviolet radare shows that reasonably accurate retrievele should be feasible down to 30 mbar or eo If multiple scattaring fe properly accounted for.

Two important themse dealt with are the etatus of paashe microwave sounding and the sensing of ocean surface paremeters. N. C. Grody discusses retrieval of temperaures and geostrophic winds with the three-channel TIROS-NASU (Microwave Sounding Unit), and shows the improvement that would be expected with a five-channel migowave sounder. D. H. Staelin discusees four microwave retrieval problems characterized by increesing nonlinearity. Doppler wind measurements, retrieval of water vapor proiles, retrieval of snow accumulation rate, and classification

of diverse ice-covered polar terrains, while P. W. Rossnkranz and W. T. Bauman present a detailed discussion with illustretive examples of the uss of the 10 pieces of information (five chennels and two polarizations) of the SEASAT and Nimbus 7 Scanning Multi-Channsi Microweve Radiometer (SMMR). Rossnkranz and Bauman show how accurecy and resolution can be traded off in the retrievel, over oceane, of auriacs temperature, wind spasd, water vapor, cloud and precipitation liquid water, and water vapor scele

The resilient problem of retrieving sea-surface tempereture is discussed in papere by M. T. Chahine, L. M. McMillan, D. S. Crosby, and J. E. DsPrisat, and H. E. Fleming who describe the usea of the apilit window technique in the infrared and of truncated normal radiance distributions to removs cloud effects. It now appears that the goal of achiaving global ass auriacs temperature distributions with accuracies of 1°C at resolutions of a few tens of kilometers from satelitle radiancea alone is within reach. A theoretical paper by P. Y. Deachamps, M. Herman, J. Lenoble, D. Tanre, and M. Viollier and an applied paper by H. R. Gordon, J. L. Mueller, and R. C. Wrigley deal with the problem of ramovel of atmospheric aerosol effacts in viaible and near infrared wavelength imagea in order to mep distributions of marine phytoplankton. Application of the technique of Gordon et al. to Images from the Nimbua 7 CZCS (Cosetal Zone Color Scanner) yields very encouraging re-

Additional interesting papers deal with the design and application of a ground-based remote sensing system (D. C. Hogg, F. O. Gulraud, C. G. Little, R. G. Strauch, M. T. Dacker, and E. R. Westwater), retrievel of stratoaphedic minor consiltuents from Nimbus 7 ilmb scanning measurements (papera by L. L. Gordley and J. M. Russell and by C. D. Rodgers), and on the thermal structure of Jupiler's atmosphere (B. J. Conrath and D. Gautler). Notobly abaent from the conference was W. L. Smith, and no pepers deal with the important area of his recent interest, the interpretation of satellite data in terms of mesoscele phe-

Conway B. Leovy is with the Department of Almospheric Sciences, University of Weshington, Seattle, Washington.

Coastal Upwelling

Francis A. Richards, editor

Coastal Upwelling, the first volume in AGU's newest book series, explores, studies, and reports on a vital part of uur ecosystem through a multidisciplinary perspective.

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Classified

The eacond conference on Remote Sansing of Aimospheree and Oceans was convened in May 1979 at Williamsburg, Va., under the auspices of the Institute for Almoepheric Optics and Ramote Sensing and the Office of Naval Research. The papere presented et the confarence are reproduced in this volume. Like the first euch confarance, in 1978, these proceedings provide a good picture of most of the major problems in the flaid at the time, and, like most such state of the art research collections, it can be expected to have a fairly ehort useful hall ille. For those actively involved in either remote seneing research, or the use of the mateorological data gathered by remote sensing techniques, this volume will be of considerable value, however. On the whole, the papers are well written and most are presented in auch a way that the important ideas can be readily appreciated by nonepecialists. The usefulness of

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ty positions. The rank for each is at the assistant or associete professor level, dependent upon qualifi-catione. The successful epplicante will be expected io develop airong research end graduele stude programa. Teaching outles will include undergra ete end greduele courses in the eress of expertise Mineral Resources/Economic Geology: One post on is in mineral resources/economic geology. An opiled ikeld orientation is preferred, lows Otale has yighteen a Attachment of the control of tion la in mineral resources/economic g assabilehed a Mining and Mineral Resources Research institute and an interdepartmental minor Mineral Resources in order to support and devi research and education in this area. In addition to the appointment in the Oepartment of Earth Sciences there will be full opportunities to interact with

lhase programs.

Geomorphology: The second position is in the general field of geomorphology. Additional experiise in an area related to geomorphology, such as groundweler, engineering sociogy or remote sensing is also desired. A person with an applied field

orientation le being sought.

Each appointment will be on an academio year
pasis. Opportunities are evelleble for summer basis. Opportunities are aveilable for summer teaching appointments. Salaries will be commensurate with qualifications. Application deadlines for both positions are Februery 15, 1982; later applications will be accepted if a position in not filled. Positions are both currently available and are expected to be filled no leter than fall, 1982. For application Information please write to:

Bert E. Nordlie Depertment of Earth Sciences 253 Science I lowa State University Ames, lowe 5001 i lowe State University is an equal opportunity/si firmetive action employer

Staff Scientists/Scientific Programmers. Research & Oefa Systems, Inc, has opening available for Steff Scientists and Scientific Programmers to work in areas involved in the processing and appropriate to the processing and appropriate the processing appropriate the processing and appropriate the processing and appropriate the processing and appropriate the processing appro plication of data from satellite based remote sensing systems. Perticular needs involve the study of atmospheric dynamics specifically as it talets to the stretosphere/reposphere interface, atratoscheric the erecephere-proposphere interece, arrangher-to composition and dynamics and dynamic feed-back mechanisms. Other needs exist in the areas of orbitvalittude computation, objective enalysis and radiative transfer. Successfut candidates will have an advenced degree in melecrology, physics, as-ironomy or matheriatics with a strong computer software background particularly on IBM equip-ment. Genid returns in confidence to; Research & Data Systems, Inc., 9420 Annapolla Road, Lanham, Manyland 20708. Telephone: (301) 458-0001

University of Hawaii: Faculty Positions The Osperiment of Geology and Osophysics and the Hawali Institute of Geophysics of the University of Heweii are seeking epplicants for two tenure track positions becoming available January 1. 1982. Applicants should have specialization in (1) manne geophysics with amphasis in one or mora of the fields marine seismology, magnetics and gravity; or (2) manne geology sedimentology. One of these positions will be filled at a rank of full profassor, the other at essistant or associate level.

Applicants should have demonstrated ability to onduct and promote marine research commensurais with the level of the application. Ability to leach et all lavels is expected. The positions will be joint ones on en 11-month basis with the Ospertment. and the Institute and will involve both teaching and

research responsibilities. Apply with rasume, ex-pected fevel of appointment and the names of 3 referees to Chairman, Personnel Committee, Ocpartmant of Gaology and Geophysics, University of Hawaii, Honolulu, Hawell 96822 Closing date for applications is Jenuary 1, 1982. The University of Hawali is an affirmative-ection/

Groundwater Hydrologist. The Minnesota Department of Natural Resources, Division of We-ters has a vacancy at the Principal Hydrologist level for an experienced groundwater hydrologist to pro-vide leadership for a program of ground water stud-les and market les and monitoring to support State Weter alloce-tion decisions and to provide quantitative assess-ments for planning and management purposes. Address inquiries and requests for application forms to: Barah P. Tufford, ONF-Division of Waters, Third Floor Space Center Building, 444 Lafayette Road, St. Paul, Minnesola, 55101. Present salary range: \$23,323 to \$31,132 annually, subject to revi

Geophysical Fluid Dynamicist Physics! Ocsa nographer. Applications are solicited for a junior faculty position in ocean physics or dynamics to begin in the academic year 1982-83. Areas of inlareal to the Deportment include analytical, nu-maiical and laboratory modeling of physical proc-

Yale University is an equal opportunity affirmative action employer and encourages women and members of minority groups to compete for this position Curriculum vitae, publications, and the names of three or more referess should be sent by 31 De-cember 1991 to: Robert & Gordon, Cheirman, Oepartment of Geology and Geophysics, P.O. Box 6666, New Haven, CT 06511

Purdue University. The Department of Geo-sciences invites applications for a leculty position. etarting January or July 1982, in the bload held of mineralogy-petrology-geochemistry. A Ph O is re-quired and preference may be given to scientists with an ealeblished record of reaearch. The Oepart-ment has an autometed electron microprobe, mass apectrometar and laboratory for stable isotope stud-ies, full range of high temperature and high pressure equipment, including furnaces for controlled fOz experiments, as well as X-ray equipment. The successful opplicant will be expected to participate in both the undergraduale teaching and graduate etudes programs, as well as actively engage in research. Rank and solary are open but will be compared to the business of the search to the programs.

mensurate with qualifications. Purdus University is a land grant, state supported institution committed to academic excellence, and is an equal opportunity equal access employer. For further information please contact Or Henry O. A. Meyer, Dept of Geosciences, Purdue Univer-

sity, West Lateyette. IN 47907 (Tel. 317-494-3271). Closing dats for applications is November 10.

SENIOK GEOPHYSICIST

A leader in the field of exploration geophysics for both resource and engineering applications located in New England is expanding its staff and has immediate openings for highly quelified geophysicists to work on both national and overseas projects.

Background musi Include Ph.D. or Mesiers and 5 years + experience in industry. Primary erea of expertise thould be interpretetion of seismic data. e familiarity with potential field studies is also highly destrable. Job responsibil-lities will include; design and management of geophysical data acquisition programs for engineering end exploration programs throughout the world; analysts end interpretation of numerous types of geophysical data and clevelopment of reports. Salary is negotiable.

If you are interested in joining a growing and dynamic organization that for over twenty-five years has provided industry and government with state-ofthe-art geophysical services, then these are excellent career possibilities for you. In eddition to positions they also are stimulating end rewarding professignel challenges which offer the opportunity for management responsibility. Located in an attractive New England setting and provides excellent benefits and salary opportunities. If you would like to be considered for one of these positions, please lonward your resume end salary hislory to:

Mr. John Doherty Post Office Box 550 Luons Street Westboro, MA 01532.

Selsmologist/University of Uteh. Search extended: the University of Utah is expending its geophysics progrem in the Constrment of Geology and Goophysics by edding a tenure track faculty member in goismology at the assistant to associate proloasor lovel. Applicants with backgrounds and scialios in seismic rollection, ao smic misqing. and theoretical seismology will be given proference The individual will be expected to leach undergrad uate and graduate courses, and to ourgue an ective esearch program with graduate cludents. The deparlmont has modern reaching and research progrants in geology and goophysics, and has close associations with the numerical analysis and data proconeing groups in computer ecionco, electricos angineering and mathematics. The geophysico component of the department has strong research end teaching programs in saismology, electricol end ofociromagnetic mothode, thermal properties of the earth, and potential fields. Current recearch in eaismology includes: selomological end oarthquake resourch utilizing e new POP 11/70 computer with platter and termine's; monitoring at the information tain setamic bell by e 55 station to amotered network utilizing a new on-line POP 11/34 computer onte in seismic refraction profiling, investigations of selemic propagation from synthetic polemagnems, application of inverse theory to selemology, solarile properties of velconic systems and allied research in tectonophysics. The closing date for applications is December 31, 1081. A Ph O. is required for this position. Applicants should submit o vito, turnocripts, a letter describing his har research and leaching goals, and names of live persons for reference to William P. Noch, Cherman, Department of Geology and Ocophysico, University of Uteh, Sali Lake City, Utah 84112. University of Utah is an equal opportunity affirmo-

Structural Geologist/University of Wyoming. The University of Wyoming, Coperiment of Geology and Geophysics conks applicants for a leaure track appointment in circulard geology op-ported to be evaluable beginning full semester 1982 or earlier. Outles will lactude tracking of undergrant uate and gradunte courses in structural geology, supervising MS and PhO theses, and research in structural geology. Appointment introseistant professor level is preferred, but applicants requesting oppointment at higher rank will be considered. Safery open. Applicanto must have PhO degrae end be versed in quantitative theory as well as hold repolications or modern electural occlopy and regional

toctonics
Applicants should provide, by Janimry 1, 1982, o resume, three letters of reference, and a letter of application including a statement of current resoarch interests mul courses which the applicant fools qualified to touch. Applications should be sent

Or. Robert S. Houston Head Department of Geology and Geophysics University of Wyomi Enrame, Wyoming 82071-3008
The University of Wyoming is an equal opportunity affirmative action omployed

Engineering Osologist Ceophysicist.
The Department of Geological Sciences, University of Saskeichewan, has a vacant lenurable posi-Lon in engineering goo'ogy geophysics. Applicants should be qualified to leach undergroduate and graduate courses and to conduct research in engineering oeology. A background in structural geolo-gy may be appropriate. Woll-equipped facilities are available for research in rock mechanics, fluid flow through porous media, acoustic, and electrical properties of rocks, and permatrost. Good apportu-nites exist for joint research with qualifications and esparience Send applications, detailed personal rasume including the names of at least three referees, and other supporting data to Dr. W.G.E. Ce'd-well, Head, Department of Geological Sciences. University of Seskatchawan, Sasketoon, Saskatchowen, S7N 0W0

Please note until November 15, 1981 consideration will be given only to eppicants who are Conadions or landed immigrants, etter thet date all appli-

Vieltor Appointments: NCAR. Vistor Ap pointments of the High Altitude Observetory ere evailable for new and established Ph O's for up to one year periods to carry out research in solar physics, so'or-terrestrial physics, and related sub-jects. Applicants should provide o curriculum vitae the names of three scientists familiar with thoir work and a statement of their research plans. Ap-picetions must be received by 15 Jenuary 1982, and they should be sent to Visitor Committee, 11 gh Ablude Observatory, National Center for Almo-spheric Research (NCARI, P.O. Box 3000, Boulder, Colorado 90307. NCAR to an equal opportunity atfirmative action omployor

University of Utehr Feoulty Positions. The Department of Geology and Geophysics invites applications for four tonury track positions of the asustant to associate professor lovel

- Economic Geology. The opecutic area of ex-pense is open, however, proference will be given to candidates whose research inter-8414 648 in neokypical psochemical or not loog cal charactoristics of metallic mineral
- deposits
 21 Sed-mentary goology. Applicants should have research infereste in modern or an confederation and section and section
- 3) Seismology Applicants with backgrounds and specialties in seismic reflection, seismic imaging or theoretical scientology will be
- given praference 41 Potential Folds: Ocophysicist with opecially in potential lineary including growty and magnetics (The closing data for this poston 19 January 3t, 1982)

A Ph O. or equivelent is required. The vacancies are to be lided by September 1982; the closing date for applications for positions t-3 is December 3t, 1981. Applicants should submit a vita, transcripts, a letter describing his her sesearch teaching goal's, and names of live persons for reletence to William P. Nash, Chairman, Department of Geolog William P. Nash, Chairman, Department of Geology and Geophysics, University of Utah, Salt Lake City,

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Feoulty Positions. Two Faculty Positions in Goology. Tenure-track positions in geology, easiel ant professorships Ph O preferred or equivalent

Petrologist-Mineralogist. Candidate must be eble to toach introductory geology, mneralogy, petrology, geochemistry, and optical mineralogy/pe-

invertebrato Paleoniologist-Soli-Reck Goologist. Candidate must be able to teach courses in Invertebrato paleontology, micropaleontology, sedimenta-flori, and historical peology. Additional expertise in recent marine onvironments highly desirable.

arong of experting, and to load aludame' held trips Strong teaching end research commitments expec ed. Submit applications with resume and copies of Irenscripts, and have three letters of rocomme tione sont to the Cheirperson, Department of Earth & Space Sciences, Indiane University-Purdue Univorolty at Fort Wayne, Fort Wayne, Indiana 46805. Indiana University Purdua University le an equal opportunity/affirmative action amployer.

Position in Reflection Seismology/Rice iversity, Houston, Texas. The Depart ment of Geology plans to expand ito geophysics program. Emphosis will be on reflection seismolo gy. At this time applications are for the first of two open faculty positions. The successful applicant will help in the search lor and selection of the second

Your main responsibility will be to lead our depariment into the area of modern reflection sele-mology. Your mein toaching and research intersele should be in the acquisition and processing of reflection selomic date You should also help in devoloping rigorous undorgraduate and graduate cur-ricule, which are supported by the traditional strongth of the Moth Sciences, Physics, and Electrical Engineering Departments of Rico. Enthusiasm to work with and underloke aerire joint projecto with

our geologists is ossenbat.
Our pinns are to acquire a computer system contigured for high quality data processing. Substantial send money for this lecility is ofready in hand. Creelive cooperation with the oil end geophysical industry in Houston, including a reasonable omount of consulting, is encouraged. Selary will be commensurate with quolificotions and experience. Please send your curriculum vifae, e summery of exportence in solamic processing, eletement of seserch intoreste, one names of three of more references to Or. A. W. Bally, Chairmen, Opportment of Geology, Rice University, P.O. Oox 1092, Houston, Toxas 77001. Application de adline—Occamber 3, 1981.

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Stenford University. A postdocloral or rosearch ossociate appointment is aveilable in the nrea of space prosma physics. Topics of study include data from electron beam expendents eboard the space shuttle and the behavior of low energy plasmo in the magnetosphere. Hosumes and names of three references should be sent to Protessor P. M. Benks, Radio Science Leboratory. Ospanmont of Electrical Engineering, Stanford University, Stanford, CA 94305. uty. Stanford, CA 91305

Stanford University is an equal opportunity em-

Foculty Position in Weterahed Hydroloey. The School of Forestry and Environmental Studies at Duke University invites epplications for both tenure-track and research eppointments in welershed hydrology, Joint oppointment with other university departments is possible

Applicants should have background in physical and biological processes important in watershed hydrology, impact of land use on water quantity and quelity, and quantitative methods including statis-tics, systems analysis, omutation. Requires Ph.O. with one degree in e natural resource area

Write for position announcement or submit curricwhite for position anisothement or submit curre-ulum vilas, representativa publications, three refer-ences by Occamber 15 to: Chairman, Faculty Council, School of Fozsatry and Environmental Studies Box EA, Ouke Univaraity, Ourham, NC

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University of North Ceroline et Cheriatto Feculty Positions in Earth Solenoes. The Department of Geography and Earth Sciences of fors en interdiociplinary major in Earth Scienceo, which includes e geology track and o developing focus on water resources. The department to seek ing to fill two tenure-tieck leculty poolfons at the Assistant Professor level to begin August, 1982; 111 Geologist with specialties in mineralogy.

patrology and possibly structural geology. Mus also toach introductory geology and have a

(2) Earth Scientist with primary into ests in citmatelogy and soils along with ahared responsicourses and possibly meteorology.

All candidates for torons track appointments
must have the Ph D Others with substantial declar

al coursework and experience will be considered for Lecturer eppointments.

Send a letter explaining your interest in either position, along with a current vites, to Alfred W. Stu-

art, Charmen, Department of Geography and Earth Sciences, UNCC Station, Charlette, NC 28223.

Phone: 704-597-2293 Clusing date for initial application is January 11. AA'EO omployer

Greduele Research Assistentships in Physical Oceanography and Meteorology. The Division of Meteorology and Physical Oceanography, School of Marine and Almospheric

Science. University of Miami, invites opplications from diudents in acience or engineering with e strong background in physics and mathematics end an interest in either the etmosphere, the ocean, or their mutual interection. Remuneration includes e yearly supend of \$7,150 plus the coal of suition (\$4,160, first year). Successful applicants may pursue either a M.O. or Ph.D. Involving work in a wide range of observet lonal-experimental or theoretical research For details and or application write: Dr. Friednoh Schoti, Division al Mateorology and Physical Oceanography, School of Mainie and Almospheric Science. University of Miami, 4600 Ricken-backer Causeway, Miami, Fiorida 33:48.

Vincent C. Kelley and Leon T. Silver **Graduate Fellowships** DEPARTMENT OF GEOLOGY THE UNIVERSITY OF NEW MEXICO

The Department of Geology of the University of New Mexico invites enplicetione for the Vincent C. Kelley and Leon T. Silver Graduete ellowshipe. The tellowehipe will be ewerded on the beels of the scholastic record and academic promise of graduate applicante. Each ellowship will provide for e generoue living etipand of \$1,000/month for 9 to 12 months, end up to \$2,000/yeer for trevet end research expenses. The Caswell Silver Foundation will pay all fultion and university feed. The ewerds ere meds on en ennuel besis, but mey be renewed for up to three years ee long ea the student meinteins excellent ecedamic etending and showe evidence of eignificent progress in research. Preference vill be given to, but le not restricted to, epplicente for the Ph.D. progrem.

An application for admission to the UNM Graduate Program, transcripts Graduele Record Exem resulte (verbel, meth & geology), three letters of reterance and a brief etatement of resserch goals are required for consideration for the tellowehipe. Application meteriale may be obtained

Rodney C. Ewing Depertment of Geology University of New Mexico Albuquerque, New Mexico 87131



The deadline for applications is March 1, 1982 for the Fall samester of 1982.

University of Leads/lectope Qualogist, Applications are invited for a post of Postdoctoral RESEARCH FELLOW in the Department of Earth Sciences for a lixed term of up to two yeers. The ch progremme of the lactope Geology Group In the Department includes Decchronology oriented particularly towards evolution of meiamorphic belts, and applications of redogenic testope Deachemistry to petrogenatic problems and the present state and past history of the carth's mentis. Equipment eveliable includes two solid-source mess opectrometero (Micromosa 30 and Isomesa 64) for Sm-Nd, U-Pb, Rb-Sr and REE determinations and two MSt0's for K-Ar and 38Ar/10Ar with supporting chemical leadily ties which era dedicated to thase programs and to projects in oceanic isolope geochemistry. The successful applicant will be expected to initially work in one or more of these holds and to collaborate in appropriate current projecto. Safery within the renge 68070-£10160 according to age, quellications and experience, informat onquiries may be made to Professor J. C. Oriden. Further particular and application formo (# desired) may be obtaine from the Registrer, The University, Leads LS2 9JT.

UK, qualing reference number 49:20:HG. Closing dete for epplications 30 November 1981.

Director of Leboratories/Building Monse er. Position requires beckground in university re search progrems or business menegement. Minimum of Master's degree preferred. Successful carideta will overese maintenence of a 4-storey leb office building; manage depertmental budgets and accounting precedures; overses technical support groupe, Selary \$22K-\$27K. Sand sesume and erenge for three current letters of reference to be sent to Dr. Michal Simon, Chairman, Ospariment of Earth & Space Ociences, SUNY Stony Brook, Stony Grack, NY 11784.

BUNY Signy Brook is an equal opportunity/affir mative action employer. AK #202 8.

Surficial Geology/Ground Water. Utah State University, Tenure freck position elening epring quarter of 1982 or left querter of 1982. Ph O. required. Rank and setery negotiable. Surtical ge-ology with emphasia on geologic lield studies and ground water with attention to both peologic and geohydrologic sapects. Emphasia on the and West Closing data November 30, 1981. USU is an effir-mative action equal opportunity employer. Depart ment of Geology (07), Uteh State University, Lo-gen, Uteh 64322.

SENIOR Physical Oceanographer \$A24,951-\$A33,616 pa

CSIRO Marine Laboratories Division of Oceanography Sydney NSW, Australia

GENERAL: CSIRO has a broad charter for research into primary and secondery industry eraes. The Organization has approximately 7,400 amployees-2,700 of whom ere research end professional scientists-located in Divisions end Sections throughout Austrelia. In March 1981, the CStRO Division of Fisherias end Ocaanogrephy wee formally separeted into a Division of Fieheries Research end e Division of Ocaenography. These Divisions collectivety form the CStRO Merina Leboratoriee, end era Australia's principal merina leboratorias, employing about 200 scientista and support aleff. The main leboratory is in Sydney and there are smaller leboratories in Brisbene and Parth.

Depending on Perliementery epprovel, the Sydney ectivities will be transferred to new leboretories to be constructed on e deep waterfront sita in Hobart, Tesmania. The appointee must be prepared to Irensfar to Hobart al eny time efter December 1982. The Austrelien Government hee elso agreed to the acquisition by CSIRO of a modern oceanographic ship to replece the presently chartered 'Sprightly.'

The interests of the Division in physical oceanography include continental shell dynemics, mixed layer end upwelling dynemics, eir-see interaction, in circulation and boundary currents, the interpretation and application of setellite date, numerical modelling and geophysical fluid dynamics.

DUTIES: The appointee will take a leading role in the initiation and conduct of research within these fielde end in reletion to existing or future progreme. On occasions, the eppointee mey be expected to perticipete in or to leed research vessel cruises.

QUALIFICATIONS: A PhD or equivalent qualification in physical oceanography, geophysical fluid dynamics or some other relevant discipline, and eeverel yeers of experienca end substantiel research achievement.

TENURE: Indefinite with superennuetion.

APPLICATIONS: In writing, quoting raference number A2425, giving full parsonel perticulere including details of qualifications and experience, copy of ecademic transcript end the nemas of at least two professional referese should reach:

The Chief Division of Oceanogrephy CSIRO PO Box 21 CRONULLA NSW 2230: AUSTRALIA Deadline: November 13, 1981.

on Systems and Applications, Inc., (SSAI) has precess as programments, or surgery, or comments of engineers to engage in Scientific Modeling and pas Arelysis activities in the eness of:

C PLASMAJONOSPHERIC PHYSICS THEO-RETICAL SIMULATIONS 2 ATMOSPHERIC/OCEANIC SCIENCES 2 ALMOST TENTIONS & RADIATIVE TRANS FER/SCATTERING STUDIES

A SATELLITE DATA ANALYSIS WEATHER/OLIMATE & SEVERE STORMS

STUDIES

ATMOSPHERICIFLUID OYNAMICS 2 SOLAR AND PLANETARY PHYSICS AND ASTRONOMY COMPLTER IMAGE PROCESSING AND

SYSTEMS DISPLAYS

9. SYSTEM BOFTWARE/HAROWARE ENGI-NEERING 10 NUCLEAR FUSION/FISSION

IL APPLIED MATHEMATICS. Tiese positions involve working with NASA/ ACMANAY scientists in metropolitiss Weshington,

A stong background in numerical olmulations, of experience in working with large scale computes required for entry level to senior ocientiet/en-companies positions. OSAI provides e congeniel acefroment, pays liberel Iringo benefits end dence any programment, pays more in any or benefits and ward boruses to its employees.
Pease send your resume with selery history and mental to: SCIENCE SYSTEMS AND APPLICATIONS INC. The Aerospace Guilding, 10210 systems Road, Suite 140, Seebrook, MO 20708.

interest Prolosson Department of Geology October 1980 (1981) primate at the University of Vermont is recruiting to a small profession at the assistant profession this begin September 1982. Field of specialize-ex should complement existing faculty expertise in priving structure and regional geology. Applica-wurs solicited in, but not resideted to, geophysn more petrology/geochronology, hydrology/ Petrone or sconomic geology. The successible unides will be expected to develop a research

program involving both graduate students (M.S.) and advanced undergraduates. Applications will b accepted until December 1981.

Candidateo should send resumo and errange for three letters of reference to be sent to:

Acting Chairmen
Department of Gaology
University of Vermont Ourlington, VT 05405
The University of Vermont is an equal opportunirmalive action employer.

Assistant/Associate Full Resosroh Profeseor. Conceive and carry out original research pro-ects in field of physical oceanography. All areas of research will be considered, but some preference will be given to applicanta interested in numerica ling, coastal zone dynamics, physics and dynamics, coestal zone dynamics, prysics end dynamics of ironte, mixing/disporsion, mesoscale and large scale ocean circulation or air-see interac-tion. Oevelopment of own research program ex-pected. Excellent opportunities for interacting with ongeing Guil Stream projects, Solor fleet group, and new remote sanaing center. Send resume and slatement of research by April 1, 1982 to: Employ-se Relations Officer, IRIG# E-090006, Personnel Office, UNIVERSITY OF RHOOE SILANO, 80 Lew-stream and Stream and Strea

ar College Road, Kingston, Rt 02891. An affirmative ection/equal opportunity employer

Assistent/Associate Protessor Marins Afleirs. Tenure track beginning Falt 1802. Teach graduele/undergraduate courses in marine scionce! technology policy, marine technology, and introductory oceanography in a successful interdisciplinary department. Scholarly research, participate in oludent edvicement and departmental edministration. PhD in a marine science end appropriete releval experience. Send reaume end 3 letters of recom mendation by 2/15/82 to: Employee Relations Offi-cer, Paraonnel Office-E-020005, UNIVERSITY OF RHOOE ISLAND, Kingeton, Rhode loland 02881, An affirmative ection/equal opportunity employer

University of Gelitornia, Davier Ignocus Patrologist. The Ospartment of Geology invites applications for a tenure-track position in the field of applications for a tenure-track position in the field of ignous patiology, at the Assistant Professor level, affective for the academic year 1982–1983. Profes-ence will be given to candidates whose research demonstrates a thorough understanding of hald, theoretical and exparimental approaches to the sci-ence and who show promise for high celibor re-earch on fundamental problems. The successful candidate will be expected to contribute affectively to the existing teaching program in Ignaous potrolo-gy at both the undergraduate and graduate levals. Departmental teclifica include a thin-section lab-oratory and electron microprobe, both of which are oratory and electron microprobe, both of which are supported by jull-time personnel, an experimental laboratory with high pressure piston cylinder and low pressure externally healed equipment, a acen-ning electron microscope, stable isotope leboratory es wall as the uduel equipment IXRF, XRO, computers, etc.). The University of Celliornie of Oovis is ocated conveniently to ereap containing all types of

Igneous rocks.

The final date for receipt of applications is February t, 1882. The University of Celifornia is an aquet pportunity offirmalive ection employer. Interested individuals should send their rosums

Jere H. Lipps, Cheir Oepartment of Geology University of Cellfornia

Yale Univarialty/Department of Geology and Geophysics. Applications are solicited for a faculty position in solid setth geophysics to bright in the academic year 1682–83. Areas of interest to the Department include seismology, exploration geophysics, mechanical and physical proportios of ocks and minerals, geomagnet

Yole University is an equal opportunity-offirmative action employer and ancourages women and mom-bers of minerity groups to compete for this position. Curriculum viteo, publications and the names of three or more referees should be sont by 31 Oc-

cembar 198t to Robart B. Oordon, Chairman, Deperiment of Geology and Goophysics, P.O. Bos. 8666, New Haven, CT 06511.

PETROLEUM DEPOSITS. It you ero financing planning, designing, exploring, drilling, or digging to connection with any form of energy, you need this complete, up-to-date book about the world's petroleum deposits includes-production and rocervos to eraas. Hardcover, 8 - 8 Inchos, 378 pagas. Teblo of contents, drawingo, indos, references, 1974. \$50. Teisch Associates, 120 Thunder Road, Sud-

STUDENT OPPORTUNITIES

Greduels Roseeroh Assistentehipe in Physical Oceanagrephy. Opportunited for graduate study with Research assistantship eval bio for students interested in M S or Ph O. progrems. A summor program with stipend is open to college juniors. Write. Douglas Caldwall, School of Oceanography, Oregon State University, Corvellis, OR 97331

Greduate Teaching & Rassarch Assistentships/University of Houston. Graduate teaching & tosearch assistantahips oveilable to qualified persons interested in Space Physics at the University of Horiston. Our experimental program features rockof & balloon-borne studies of the lonosphore & megnetosphere-lonosphere coupling Emphosis has been on octive experiments, most ecent froing a rocket balloon campaign of Siple station, Antorctico in Occomber 1980 Future world includes a study of pulsining ourset & participation in Weterhole it, an automit queuching experiment The theoretical program is on plasma waves in thu solar wind & modeling of phenomena related to current experiments. Assistantinips for first year stirdents boom at \$600 mo ntong with out of glate tulion walvara Oraduata Chairman, Physics Dont. University of Houston Contral Campus, Heiston,

Meetings

Solar-Terrestrial Physics Symposium

The Fifth Internetional Symposium on Solar-Terrestrial Physics will be held in Ottawa, Canada, on May 17–22, 1982, the week before the 1982 COSPAR (Committee on Space Research) meeting. Deedline for abstracts for the de lenstrief physics meeling le December 31.

Acommemoration of the enniversaries of the Internationa Poler Yeer, the Internetional Geophysical Yeer, and the Aginning of the spece ere is plenned. The 18 ecientific sessions that highlight the meeting ere divided into 4 cete-Wiss sun, interplenetery medium, magnetosphere end knosphere, end middle etmoephere/thermosphere. Physial interpretetione end theory will be emphasized; discusson of date and instrumental techniques will be discour-

In addition, eight tutorief lectures will eddrese scientific problems of current interest. The symposium will conclude with tive general reviews on human interactions with the solar-terrestriel environment end a public forum on longlange plans for research in solar-tarrestriel physics.

Send ebstracts and requests for additional information to wan G. Roederer, chelrmen of the progrem committee, Woohysicel Inetitute, University of Aleeka, Feirbenke, AK 9701 (telephone: 907-479-7282). Only one peper per aufor will be accepted because of time limitation during the

The symposium fe organized by the Scientific Committee Seler-Terrestriel Physics (SCOSTEP) with the cosponsomple of COSPAR, the Internetional Association of Geo-Regnetism and Aeronomy (IAGA), the international Union Radio Science (URSI), end the Internetionet Union of Pure and Applied Physics (IUPAP). S

NASA Geodynamics Conference

The Fourth Annuel Conference on the NASA Geodynamics Progrem has been scheduled for January 26-29, 1982. et the Godderd Spece Flight Center in Greenbelt, Md.

Sponsored by NASA heedquerters, the conference will cover the use of space techniques to study crustal detormetion, plete etability, poler motion, earth rotation, grevily end megnetic fields, end regional atress.

Abstrects of papers to be considered for presentation at the conterence should be sent to Jim Murphy, Program Coordinetor, NASA Heedquertere, Weshington, D.C. 20546, Attn: ERG-2; deedline is November 23. Abstrect format is aveileble from Murphy. The conference coordinator, Petrick Teylor, requeels that ell those who wish to perticipete in the conference notify him by December 11. Write to him et NASA/Godderd Spece Flight Center, Code 922, Greenbelt, MD 20771 (telephone: 301-344-5554 or -5213). 6

Nominations for AGU Fellows and Awarde

November 15 is the deadline for nominations from the membership for AQU Fellows and Occambur 15 for awards ations for Fellows must be made on form for 1682. Nominations for Fellows must be made on form ovolloble from the AGU office. Nominations for medalists and awardase require only a letter of nomination and sup-porting moterial. The Bowls Medal, Ewing Medal, Horton Medal, and Macelysine Award committees are accepting ne for 1982 at this time.

American Geophysical Union 2000 Florida Avenue, N. W.

Scholarship Assistance for Minority Students in Earth. Space, and Marine Science For 1982-1983

The American Geophysical Union is once again pleased to participate in the American Corological Institute's Minorito-Scholarship Assistance Program

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Application Deadline, February 1, 1982

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